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Letter to the Editor

Non-invasive programmed stimulation vs. electrophysiological study in patients with pacemaker

Keywords:
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Cardiac hypertrophy

It is well established in the literature the relationship between structural heart disease and the occurrence of sudden cardiac death (SCD). In more than 70% of cases, the underlying heart disease is myocardial ischemia. The pathophysiology results from the interaction between the generator event and electrical instability inducing ventricular tachycardia, which degenerates into ventricular fibrillation. The high mortality resulting from these recurring ventricular tachyarrhythmias stimulated the development of various therapies with the purpose of preventing SCD, among which the surgical approach or radiofrequency ablation or resection aiming the elimination of arrhythmogenic focus and electrical treatment for cardiac stimulation artificial implantable cardioverter-defibrillator (ICD) and cardiac resynchronization therapy (CRT) [1]. The ICD was introduced in clinical practice in patients surviving a cardiac arrest due to ventricular fibrillation or sustained ventricular tachycardia hemodynamically unstable and associated with structural heart disease, so for secondary prevention of sudden cardiac death [2,3,4,5,6]. Several DDD pacemaker patients have structural heart disease with concentric and/or eccentric hypertrophy, and moderate systolic dysfunction presenting episodes of non-sustained ventricular tachycardia spontaneous recorded by the device, without ICD implantation indication.

In this study, we evaluated 112 patients with DDD pacemaker (St. Jude Medical, St. Paul, Minnesota, USA), concentric and/or eccentric hypertrophy, and moderate systolic dysfunction presenting episodes of non-sustained ventricular tachycardia spontaneous recorded by the device, without ICD implantation indication, age between 18 and 80 years, and patients who provided documentation not presenting cardiac ischemia evidenced by myocardial scintigraphy at rest and during stress, echocardiography during stress or coronary angiography. We divided the patients into 2 groups: 52 patients underwent non-invasive programmed stimulation (NIPS) by the pacemaker, and 60 patients were submitted to electrophysiological study (EPS). The baseline features of both groups are demonstrated in Table 1. All patients underwent NIPS or EPS with three extra-stimuli coupled to a programmed cycle length of 430 ms (140 ppm). The results were expressed as the mean and standard deviation (mean ± SD) of the mean in the case of normal distribution and as the median with inter-quartile range otherwise. Statistical tests were all two sided. Comparisons between two-paired values were performed by the paired t-test in case of Gaussian distribution or, alternatively, by the Wilcoxon test. All statistical analysis was performed using the program Graphpad Prism v 7.0 (Graphpad software, La Jolla, CA, USA).

The mean extra-stimuli sequence to induce ventricular tachycardia was a programmed cycle length of 430 ms (S1S1) composed by 8 extra-stimuli (S1 count), followed by S1S2 = 275 ± 22 ms, S2S3 = 240 ± 15 ms and S3S4 = 220 ± 9 ms in the NIPS group ($P < 0.0001$ for all the extra-stimuli comparisons into the same group), and S1S2 = 300 ± 16 ms, S2S3 = 270 ± 24 ms and S3S4 = 230 ± 11 ms in the EPS group ($P < 0.0001$ for all the extra-stimuli comparisons into the same group). All the comparison of the same extra- stimulus between groups were significant, ($P < 0.0001$ for all of them), as shown in Fig. 1. The incidence of ventricular tachycardia/fibrillation induction was higher in EPS group (52%) than in NIPS group (29%), $P = 0.0206$, as shown in Fig. 2.

Our results show that EPS is more effective to induce VT/VF than by NIPS protocol in the same type of population. The number of subjects who developed VT/VF was 23% higher in the group submitted to EPS.

Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

Table 1
General features of patients at baseline.

Parameters	NIPS	EPS	P value
N	52	60	–
Age (years)	64.5 ± 14.4	69.8 ± 18.3	0.0948
Body mass index, kg/m^2	29.7 ± 4.2	30.6 ± 5.1	0.3148
Male sex (%)	35 (67%)	39 (65%)	0.8433
White ethnicity (%)	33 (63%)	36 (60%)	0.8457
Hypertension	40 (77%)	42 (70%)	0.5217
Type 2 diabetes mellitus	30 (58%)	44 (73%)	0.1094
Coronary artery disease	42 (81%)	45 (75%)	0.5028
Echocardiographic parameters			
LV ejection fraction (Simpson), %	38.5 ± 7.2	41.0 ± 9.1	0.1136
LV mass index, g/m^2	155.1 ± 18.2	147.4 ± 19.3	0.0351
LV internal dimension at the end of diastole, mm	62.4 ± 10.0	60.8 ± 9.3	0.3825
LV internal dimension at the end of systole, mm	50.5 ± 12.1	53.2 ± 13.8	0.2768
Mean 24-hour ABPM, mmHg	128 ± 8/ 81 ± 4	126 ± 7/ 80 ± 6	0.3509 0.3946
Antihypertensive			
β-blocker	52 (100%)	60 (100%)	1.0000
ACE-inhibitors/ARB	52 (100%)	60 (100%)	1.0000
Spironolactone	52 (100%)	60 (100%)	1.0000
Diuretics	30 (58%)	42 (60%)	0.8534
DHP calcium channel blockers	10 (19%)	14 (23%)	0.6498

Values are presented as mean ± SD or %; ABPM, ambulatory blood pressure measurements; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; DHP, dihydropyridine; EPS, electrophysiological study; LV, left ventricular; N, number of patients; NIPS, non-invasive electrophysiological study.

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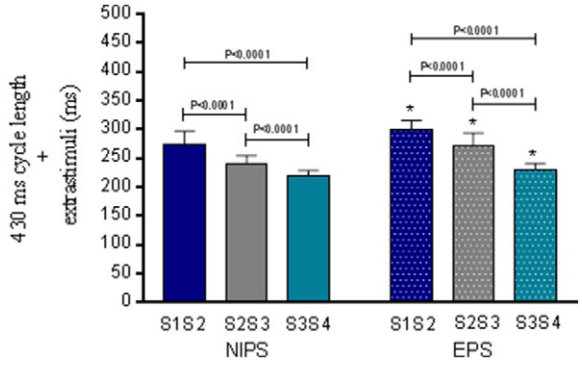

Fig. 1. Mean extra-stimuli sequence to induce ventricular tachycardia was a programmed cycle length of 430 ms (S1S1) composed by 8 extra-stimuli (S1 count), followed by S1S2, S2S3 and S3S4 in the NIPS (n = 52) and EPS (n = 60) group. *P < 0.0001 for comparisons of the same extra-stimulus between groups; EPS, electrophysiological study; NIPS, non-invasive programmed stimulation.

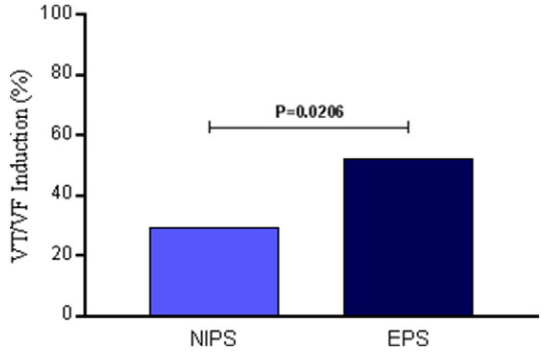

Fig. 2. Incidence of ventricular tachycardia/fibrillation induction in EPS (52%) and NIPS (29%) group; EPS, electrophysiological study; NIPS, non-invasive programmed stimulation; VT, ventricular tachycardia; VF, ventricular fibrillation.

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